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EFFECT OF DEFERENT LEVELS OF PROBIOTIC (*LACTOBACILLUS* SP.,) ON FISH PERFORMANCE, SURVIVAL AND FEED EFFICIENCY OF STRIPED MULLET (*MUGIL CEPHALUS*) FED ON ALL PLANT DIET.

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SUMMARY

This experiment was conducted to study the effect of deferent levels of probiotic as a feed supplemented on growth performance, survival rate, feed efficiency and body composition of striped mullet *Mugil cephalus* (3.75g initial body weight) fed on all plant diet. Six experimental diets were formulated to contain isonitrogenous (25% crude protein) and isocaloric (232 kcal metabolizable energy /100 g) diets; each diet was used to feed duplicate groups of fish for 12 weeks. First treatment was control diet T1 containing fish meal and plant protein sources, T2 all plant protein sources without probiotic supplement, diets from T3 to T6 containing all plant protein sources supplemented with 0.5, 1.0, 1.5 and 2.0 % probiotic (*Lactobacillus* sp.,) respectively. The results showed that fish fed diet supplemented with probiotic levels were significantly higher in growth performance and feed utilization than fish fed on control diet (T1) or all plant protein diet (T2). Moreover, fish fed on diet supplemented with 1 or 1.5% probiotic levels were significantly ($P<0.05$) better in specific growth rate, percent body weight increases and feed conversion ratio than fish fed other treatments. Fish body moisture content did not differ significantly among treatments while lipid content in fish body improved significantly ($P<0.05$) with increasing the probiotec level in the diet up to 1.5%. Similarly, the whole-body protein content increased ($P<0.05$) gradually with increasing the probiotec level in the diet up to 1.5%. The present results recommended that 1% probiotic level in the fish diet can be supplemented to all plant protein diet to improve growth performance and feed utilization of striped mullet *Mugil cephalus* and reduce the cost of fish feeds.

Keywords: *Striped mullet; Mugil cephalus; probiotic; (Lactobacillus sp.,); all plant protein diet; growth performance; feed utilization.*

INTRODUCTION

Nutritive value of fish diet depends on quality of the protein ingredients used in the diet formulation (Glencross *et al.* 2007). Animal protein sources, especially fish meal, have relatively high cost, limited supply, and variable quality (Li *et al.*, 2009). The development of commercial aquatic feeds has been traditionally based on fish meal as the main protein source because of its high protein content and balanced essential amino acid profile. Fish meal is also an excellent source of essential fatty acids, digestible energy, minerals, and vitamins (Nguyen *et al.*, 2009). Therefore, it is no surprise that fish meal is the most expensive protein source in animal and aquaculture feeds (Tacon, 1993 and Gaber, 2006). Currently, aquaculture diets consume between 35 and 40% of the world's fish meal supply, but this is projected to reach 70% by 2015 (New and Wijkstom 2002). It is evident that many developing countries will be unable to depend on fish meal as the major protein source in aquafeeds in the future. Therefore, finding suitable and cheap local protein sources as an alternative to fish meal is important to the aquafeed industry (Li *et al.* 2010). Unfortunately, plant proteins have some negative qualities such as poor palatability, low digestibility, antinutritional factors and other unknown factors (Gatlin *et al.* 2007). How to improve the utilization of plant protein sources in aquafeeds remains to be an important aspect. Therefore, specific strategies and techniques to increase the use of plant feedstuffs in aquafeeds and limit potentially adverse effects of bioactive compounds on farmed fish are worth research (Lin *et al.* 2007 and 2010).

The microbiota of the gastrointestinal tract plays important roles in the health and performance of the host (Fioramonti *et al.*, 2003; Patterson and Burkholder, 2003). Recently, there has been increased interest in altering the intestinal microbiota of the host by introducing beneficial bacteria into the diet, termed probiotics (Fioramonti *et al.*, 2003). Probiotics was known for its antagonism to pathogen and improvement of microflora balance in human and animal (Fuller 1992; Gatesoupe 1999). Also, Probiotics are live microbes that may serve as dietary supplements to improve fish growth and health (Gatesoupe 1999; Irianto and Austin 2002; Kesarcodi-Watson *et al.*, 2008). Verschuere *et al.* (2000) reported that probiotics have beneficial effects on the host by modifying the host-associated or ambient microbial community of the gastrointestinal tract thus promoting better feed utilization, enhancing the host response towards disease and improving the quality of its ambient environment. Potential use of probiotics to enhance the resistance of aquatic animals to environmental stress has aroused increased interest worldwide (Abdel-Tawwab *et al.*, 2010). Previous studies have demonstrated that oral administration of probiotic improves health of larval and juvenile fish, disease resistance, growth performance and body composition, however, the mode of action in fish species may vary between farmed fish species culture in freshwater and marine environments (Nikoskelainen *et al.*, 2003; Panigrahi *et al.* 2005, 2007; Salinas *et al.*, 2005; Kim and Austin 2006; Pirarat *et al.*, 2006; Essa *et al.* 2010).

Mullet (*Mugillidae*) are considered as one of the important fish species for mono and polyculture systems in Egypt. They represent some of the most promising species for commercial aquaculture and have strong market demand and high price in many countries (Benetti and Fagundes Netto 1991, Amer, 2000, El Dahhar 2006; El Dahhar *et al.*, 2011). Mullets are also good candidates and play an important role in the fisheries and fish farms of tropical and subtropical countries of the world (Nash and Shehadeh 1980). However, there are limited data on using probiotic as feed supplement in striped mullet diets and the use of dietary probiotic to enhance mullet performance is rarely evaluated.

Therefore, the objective of this work was to evaluate the possibility of reducing fish meal diet by all plant protein diet supplemented with deferent levels of probiotic and their effect on growth performance, survival, body composition and feed efficiency of striped mullet *Mugil cephalus*.

MATERIALS AND METHODS

The Experimental Fish:

This experiment was carried out at the fish production laboratory, Faculty of Agriculture (Saba Bacha), Alexandria University, Egypt. Striped mullet *Mugil cephalus* used in this study were obtained from privet fish hatchery in Kafr El-Shikh government. Fish with an initial body weight of 3.75 ± 0.09 g were acclimatized in tanks of 1 m^3 capacity to laboratory conditions and artificial diets for three weeks until the beginning of experiment in April 2011. Fish were divided randomly to 6 groups in duplicate of 17 fish in each group per tank. Tanks were supplemented with continuous aeration; water was exchanged partially every day by freshly stocked dechlorinated tap water. Tanks were cleaned every day before feeding. Average water temperature was 26°C. Fish were fed twice daily at 9.00 and 14.00h to apparent satiation. Fish were weighed and take their length at the beginning of the experiment and then biweekly for 12 weeks experimental period.

Diet formulation and preparation:

Six practical diets were formulated in this study to contain isonitrogenous (25% crude protein) and isocaloric (232 kcal metabolizable energy /100 g) diets based on feedstuff values reported by NRC, (1993). Diets were formulated from commercial ingredients of fish meal, wheat flour, wheat bran, soybean meal, yellow corn, bone meal, fish oil, vitamins and minerals mixture. The chemical analysis of the experimental diets are presented in Table 1. Treatments were: T1 both fish meal and plant protein sources as a control, T2 all plant protein sources without any addition, T3 all plant protein sources supplemented with 0.5% probiotic level, T4 all plant protein sources supplemented with 1.0% probiotic level, T5 all plant protein sources supplemented with 1.5% probiotic level and T6 all plant protein sources supplemented with 2.0% probiotic level. Probiotic (*Lactobacillus* sp.,) (produced by Pura2A company, Cairo, Egypt) contain from commercial formulation of dried probiotic bacteria (*Lactobacillus plantarum, Lactobacillus fermentum, Lactobacillus delbrueckii, Bacillus subtilis, Saccharomyces cerevisiae, Rhodopseudomonas palustris*). Fish oil emulsified with equal amount of water using 0.7% phosphatediyl choline (lecithin) according to El-Dahhar and El-Shazly (1993) was added to the diets. Mixtures were homogenized in a food grinder mixer. Boiling water was then blended into the mixture at the ratio of 50% for pelleting. Diets were pelleted using meat grinder with a 1.5 mm diameter and kept dry until they were used. With a maximum pressure of 1.2 kg /cm^2 G, an autoclave was used to heat treat the diets for 15 minuets after adding boiling water. Vitamins and minerals mixture and probiotic (*Lactobacillus* sp.,) were added to the diets after heat treatment. Gross energy was calculated from Macdonald's Tables as crude protein, crude fat and carbohydrate to be 5.8, 9.3 and 4.1kcal/g respectively (Macdonald *et al.*, 1973).

Table (1): Composition and proximate analysis of diets used in this study.

Ingredients	Probiotic levels					
	T1 control	T2 All plant	T3 0.5%	T4 1.0%	T5 1.5%	T6 2.0%
Wheat flour	17	12	12	11.5	11.5	11
Wheat bran	31	25	24.5	24.5	24	24
Soybean meal	24	47	47	47	47	47
Yellow corn	9.5	9.5	9.5	9.5	9.5	9.5
Fish meal	12	0	0	0	0	0
Fish oil	3.5	3.5	3.5	3.5	3.5	3.5
Probiotic	0	0	0.5	1.0	1.5	2.0
Bone meal	2	2	2	2	2	2
Vit &Min Mix*	1	1	1	1	1	1
Proximate analyses%						
Moisture	10.23	10.83	10.78	10.29	10.65	10.49
Crude protein	24.86	24.72	24.69	24.64	24.76	24.53
Crude fat	11.41	11.17	10.94	10.88	11.06	10.83
crude fiber	4.67	4.61	4.84	4.59	5.02	4.67
NFE**	39.11	38.54	38.52	39.43	37.67	39.13
Ash	9.72	10.13	10.23	10.17	10.84	10.35
ME (Kcal/100 g diet)	232.03	231.05	231.43	230.90	230.37	230.02

Content/kg of Vitamin & minerals mixture. Vitamin A, 4.8 MIU; Vitamin D, 0.8 MIU; Vitamin E, 4.0 g; Vitamin K, 0.8 g; Vitamin B_1, 0.4 g; Vitamin B_2, 1.6 g; Vitamin B_6, 0.6 g; Vitamin B_7, 20.0 mg; Vitamin B_{12}, 4.0 g; Folic acid, 0.4 g; Nicotinic acid, 8.0 g; Pantothenic acid, 4.0 g; Colin chloride, 200 g; Zinc, 22 g; Cooper, 4.0 g; Iodine, 0.4 g; Iron, 12.0 g; Manganese, 22.0 g; Selenium, 0.04 g.

** *NFE is nitrogen free extract calculated by difference= 100- (protein +lipid +ash +fiber)*

Parameters of growth performance:

Growth performance was determined, and feed utilization efficiency was calculated using the following equations:

Weight gain = $W_2 - W_1$.
Specific growth rate (SGR; % g/day) = 100 (Ln W_2 – Ln W_1) / T.
Percent body weight increases (% BWI) = ($W_2 - W_1$) 100/ W_1.
Condition factor (K) = 100[W_2/ (total length)^3].

Where W_1 and W_2 are the initial and final fish weights, respectively, and T is the experimental period in days.

Feed conversion ratio (FCR) =feed intake / weight gain.
Protein efficiency ratio (PER) = weight gain/protein intake.
Protein productive value (PPV %) = 100 (protein gain/protein intake).
Energy retention (ER %) = 100 (energy gain/ energy intake).

Chemical analysis of diets and fish:

Samples of fish at start and five from each tank at the end of the experiment were taken randomly and were frozen for body chemical analysis. Frozen samples were dried at 70°C for 72 h and passed through a meat grinder into one composite homogenate per tank. Chemical analysis of homogenized fish and experimental diets were carried out according to the methods of Association of Official Analytical Chemists AOAC (1990) for moisture (oven drying), protein (macro-keldahl method), fat (ether extract method), crude fiber (fritted-glass crucible method) and ash (muffle furnace).

Statistical analysis:

The obtained data were subjected to one-way ANOVA (complete randomized design). Differences between means were tested at the 5% probability level using Duncan's new multiple range test by Duncan

(1955). All the statistical analyses were done using SPSS program version 10 (SPSS, Richmond, USA) as described by Dytham (1999).

Economical evaluation:

The cost of feed required to produce a unit of fish biomass was estimated using a simple economic analysis. The estimation was based on local retail sale market price of all the dietary ingredients at the time of the study. These prices (in LE/kg) were as follows: fish meal, 11; soybean meal, 3.5; yellow corn, 4.0; wheat flour 3.0, wheat bran 2.50; fish oil, 7.0; vitamin& mineral mixture, 7.0; bone meal, 2 and 12 LE/ Liter probiotic.

RESULTS AND DISCUSSION

The results of striped mullet *Mugil cephalus* in the present study have shown that final body weight (FBW), weight gain (WG), specific growth rate (SGR%/day) and feed conversion ratio (FCR) were significantly ($P<0.05$) affected by different dietary probiotic levels. The highest significant ($P<0.05$) values of FBW and WG (Table 2) were recorded at T4 diet (all plant diet plus 1% probiotic level) they were 10.86 and 7.10 gm respectively, followed by T5 diet (all plant diet plus 1.5% probiotic level) then T1 diet (control fishmeal diet), T6 diet (all plant diet plus 2% probiotic level) and T3 diet (all plant diet plus 0.5% probiotic level) where differences among last three groups were not significant ($P<0.05$) and the least significant ($P<0.05$) values of FBW and WG were recorded with fish maintained at T2 diet (control all plant diet) there were 7.3 and 3.47 gm respectively. Similarly, the highest significantly ($P<0.05$) values of SGR were obtained with fish maintained at T4 and T5 diets (all plant diet plus 1% and 1.5% probiotic levels) they were 1.33 and 1.25 respectively, while the lowest value ($P<0.05$) 0.81 was recorded with fish feed at T2 diet (control all plant diet). Moreover, fish maintained at the diet contained probiotic were better in growth performance and feed efficiency ($P<0.05$) than fish maintained at control fish meal diet or all plant protein sources diet only. These results are in agreement with that reported by Essa *et al.* (2010) with Nile tilapia (*Oreochromis niloticus*), they showed that growth and feed utilization of fish fed on diets containing different probiotic groups were improved significantly compared to fish fed on control diet and they recommended the incorporation of probiotics to fish feed as supplements to stimulate fish growth and digestion. Essa *et al.* (2010) demonstrate that beneficial effects of probiotics on fish growth appears to be associated with colonization of favorable microbiota in the gut wish produce enzymes that hydrolyze complex molecules facilitate better digestion and absorption of macronutrients resulting in higher protein and energy retention in the body.

Results in Table 2 showed that fish fed at T4 and T5 diets (all plant diet plus 1% and 1.5% probiotic levels respectively) were significantly higher ($P<0.05$) in body weight increases percent BWI% (188.83 and 171.27% respectively) compared with the fish fed at other treatments, while fish fed at T2 diet (control all plant diet) was the lowest BWI % (90.60%). Also, data in Table 2 showed that best values of K factor were obtained with fish fed at T4 and T5 diets (all plant diet plus 1% and 1.5% probiotic levels, respectively) while worst value of K factor was recorded with fish fed at T2 diet (control all plant diet). Survival rate at the end of the experiment showed that there were insignificant differences ($P>0.05$) among treatments, it ranged between 75.51 and 82.35 %.

Table (2): Means ± standard error (SE) of final body weight (FBW), weight gain (WG), specific growth rate (SGR%/day), percent body weight increases (% BWI) and k factor of striped mullet *Mugil cephalus* fed at different dietary levels of probiotic.

Treatments	FBW (g)	WG (g)	SGR %/day	BWI %	K factor
T1 Control	8.11 ± 0.12^{c}	4.39 ± 0.21^{c}	0.97 ± 0.04^{b}	118.01 ± 7.1^{b}	0.89 ± 0.03^{c}
T2 All plant	7.30 ± 0.10^{d}	3.47 ± 0.17^{d}	0.81 ± 0.03^{c}	90.60 ± 4.5^{c}	1.38 ± 0.05^{a}
T3 (0.5%)	7.76 ± 0.11^{c}	3.94 ± 0.19^{c}	0.89 ± 0.05^{bc}	103.14 ± 2.4^{bc}	0.83 ± 0.04^{c}
T4 (1%)	10.86 ± 0.21^{a}	7.10 ± 0.26^{a}	1.33 ± 0.08^{a}	188.83 ± 6.7^{a}	0.61 ± 0.02^{d}
T5 (1.5%)	10.20 ± 0.17^{b}	6.44 ± 0.15^{b}	1.25 ± 0.04^{a}	171.27 ± 3.2^{a}	0.68 ± 0.03^{d}
T6 (2%)	7.97 ± 0.16^{c}	4.25 ± 0.10^{c}	0.95 ± 0.03^{b}	114.25 ± 4.3^{b}	1.11 ± 0.07^{b}

Means in each column followed by different letter are significantly different ($P< 0.05$).

These results agree with that found by Aguilar-Macias *et al.* (2010). They stated that all natural probiotics were beneficial and improved survival and growth of juvenile pearl oyster, *Pinctada mazatlanica*. Also, Amer and El-Tawil (2011) concluded that the addition of probiotic (*Lactobacillus* sp.,) as feed supplements to red tilapia (*Oreochromis sp.*) diets have a positive effect on growth performance and feed utilization of fish. Abdel-Tawwab *et al.* (2010) found the same results on growth performance for Galilee tilapia *Sarotherodon galilaeus*. Fish fed on diets supplemented with live baker's yeast *Saccharomyces cerevisiae* used as a probiotics were stronger and healthier. Also, they suggest that yeast supplementation enhanced the resistance of fish against waterborne copper toxicity.

With respect to body composition of striped mullet, results in Table 3 observed no significant differences (P>0.05) between treatments in body fish moisture contents. On the other side, lipid content in fish body increased with increasing the rate of probiotic in the diet, fish maintained at T5 and T6 diets (all plant diet plus 1.5and 2.0% probiotic levels respectively) were significantly (P<0.05) highest lipid content than other treatments, values were 9.69 and 8.91% respectively, while lowest value (P<0.05) was obtained with fish maintained at T1 diet (control fish meal diet) it was 6.01%. Other treatments were intermediate last two groups.

Table (3): Mean ± standard error of moisture, protein and lipid contents in the carcass of striped mullet *Mugil cephalus* fed at different dietary levels of probiotic.

Treatments	Moisture %	Protein %	Lipid %
T1 Control	72.70 ± 1.02	15.34 ± 0.23[bc]	6.01 ±0.05[c]
T2 All plant	71.39 ± 0.26	15.19 ± 0.31[c]	6.97 ± 0.13[b]
T3 (0.5%)	72.04 ± 1.04	15.27± 0.12[bc]	6.72 ± 0.16[bc]
T4 (1%)	69.46 ± 2.46	15.81± 0.40[bc]	7.22 ± 0.03[b]
T5 (1 .5%)	68.38 ± 1.61	16.64 ± 0.27[a]	9.69 ± 0.62[a]
T6 (2%)	69.96 ± 0.51	15.96 ± 0.13[ab]	8.91 ± 0.27[a]

Means in each column followed by different letter are significantly different (P< 0.05).

Results of protein content showed significant differences (P<0.05) between treatments where protein content increased gradually with increasing the rate of probiotic in the diet up to 1.5%. Generally, the highest significant body protein content (P<0.05) was found with fish maintained at T5 diet (all plant diet plus 1.5% probiotic level) with value of 16.64%, followed by fish maintained at T6 diet (all plant diet plus 2% probiotic level) 15.96% without any significant differences between the two treatments, while the lowest significant (P<0.05) body protein content was found at the fish maintained at T2 diet (control all plant diet) with the value of 15.19%. In the present study formulation of dried probiotic bacteria contain mainly (*Lactobacillus* sp..), Ringo and Gatesoupe (1998); Venkat *et al.* (2004) reported that (*Lactobacillus* sp.,) are effective as a probiotics in animal nutrition. Moreover, The beneficial effects of (*Lactobacillus* sp.,) on growth response have been observed in published studies involving other fish species like Nile tilapia by Lara- Florest *et al.* (2003), sea bream *Sparus aurata* Suzer *et al.* (2008) and European sea bass *Dicentrarchus labrax* by Carnevali *et al.* (2006).

Values of feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV %), and energy retention (ER %) of striped mullet *Mugil cephalus* are shown in Table 4. Data indicated that fish maintained at T5 and T4 diets (all plant diet plus 1.5% or 1% probiotic levels) had significantly (P<0.05) better FCR than other treatments, values were 1.63 and 1.65 respectively. Differences among other treatments were not significant (P<0.05).

Table (4): Mean ± standard error of feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV %), energy retention (ER %), of striped mullet *Mugil cephalus* fed at different dietary levels of probiotic.

Treatments	FCR	PER	PPV%	ER%
T1 Control	1.74 ± 0.04[a]	2.34±0.04[b]	38.59±1.29[cd]	23.34± 0.58[d]
T2 All plant	1.72 ± 0.05[a]	2.32±0.02[b]	37.09±1.89[d]	28.21± 1.57[c]
T3 (0.5%)	1.71 ± 0.08[a]	2.37± 0.04[b]	38.42±0.52[cd]	25.45± 1.92[cd]
T4 (1%)	1.65 ± 0.04[b]	2.46± 0.05[a]	40.88±2.37[bc]	27.82 ± 1.07[c]
T5 (1.5%)	1.63 ± 0.02[b]	2.47± 0.03[a]	44.63±3.84[a]	35.84 ± 0.34[a]
T6 (2%)	1.70 ± 0.03[a]	2.35± 0.02[b]	41.07±2.53[bc]	32.41 ± 0.55[b]

Means in each column followed by different letter are significantly different (P< 0.05)

The best PER ($P<0.05$) was obtained with the fish maintained at T5 and T4 diets (all plant diet plus 1.5% and 1% probiotic levels) with values of 2.47 and 2.46 respectively, which were higher significantly ($P<0.05$) than other treatments. The differences among the last treatments were not significant. Similarly, results indicate that highest significant ($P<0.05$) value of PPV% was found with fish maintained at T5 diet (all plant diet plus 1.5% probiotic level) with the value of 44.63%, while the lowest significantly PPV% was found with fish maintained at T2 diet (control all plant diet) with the value of 37.09%. Data of energy retention (ER%) as shown in Table 4 indicated that fish maintained at T5 diet (all plant diet plus 1.5% probiotic level) was higher significantly ($P<0.05$) than other treatments, it was 35.84% followed by T6 diet (all plant diet plus 2% probiotic level) then T4 diet (all plant diet plus 1% probiotic level), T3 diet (all plant diet plus 0.5% probiotic level), T2 diet (all plant diet) and finally control fish meal diet. Authors in previous studies explain that the improve in feed utilization could be due to improvement in intestinal microbial flora balance which in turn will lead to better nutrient digestibility, higher adsorption quality and increased enzyme activities (Balcazar *et al.* 2006; Wache *et al.*2006; Suzer *et al.*2008; S'aenz de Rodriganez *et al.*2009). Also, more degradation of higher molecular weight protein to lower molecular weight peptides and amino acids (De Schrijver and Ollevier, 2000). These contribute towards optimizing use of protein for growth that will result in more efficient protein in fish diet.

Results in the present study showed that fish fed on the diet containing fish meal (T1) was significantly higher in the growth performance than other fish fed diet containing all plant protein sources only (T2 diet). Nguyen *et al.* (2009) reported that fish meal is an excellent source of essential fatty acids, digestible energy, minerals, and vitamins. Moreover, animal protein sources especially fish meal is the main protein source because of its high protein content and balanced essential amino acid profile (Li *et al.* 2009). On the other side, results showed that fish fed diet contain all plant protein sources supplemented with probiotic was significantly higher in the growth rate and feed efficiency than fish fed on control diet (fish meal diet). These results are in agreement with that reported by Gaber (2006). He demonstrated that as much as 100% of the fish meal protein could be replaced by soyabean meal supplemented with *Yucca schidigera* in commercial production of tilapia. Moreover El-Saidy and Gaber (2002) reported that soyabean meal supplemented with 1% methionine can totally replace fish meal in Nile tilapia diets. Also, Sink *et al.* (2010) indicate that all plant protein diet is equally effective for growth and survival of catfish fry when compared to diets with animal derived protein. The replacement of animal protein sources, such as fish meal, with plant ingredients like soyabean meal would reduce the costs of fry feeds. Moreover, Lovell (1989) reported that freshwater omnivorous, such as tilapia (*Oreochromis* sp) and channel catfish (*Ictulurus punctutus*) can be completely replace fish meal in the diet by plant protein sources such as soybean meal.

Economic evaluation of the experimental diets is shown in Table (5). There was a reduction in feed cost to produce 1 kg of fish weight gain of 21.52 and 21.41% for the all plant diet supplemented with 1.0 and 1.5% probiotic level/ kg diet respectively, compared to the control fish meal diet. Nguyen *et al.* (2009) indicated that the use of all plant protein diet or using non-fish meal protein sources in fish diet reduced cost and increased profit in feeds of fish. From the results of this study, it could be recommended that 1% probiotic level in the diet can be supplemented to all plant protein sources diet to improve fish performance and feed utilization of striped mullet *Mugil cephalus*. Moreover, the replacement of animal protein sources, such as fish meal, with plant ingredients similar to those used in the present study reduce the costs of the fish feeds.

Table (5): Economic efficiency for production of one kg gain of striped mullet *Mugil cephalus* fed at different dietary levels of probiotic.

Item	Probiotic levels (mg/kg)					
	Control	All plant	0.50%	1.0%	1.5%	2.0%
Price/ kg feed L.E	4.18	3.36	3.41	3.45	3.50	3.55
FCR (kg feed/kg gain)	1.74	1.72	1.71	1.65	1.63	1.70
Feed cost / kg gain L.E	7.27	5.78	5.83	5.70	5.71	6.03
Reduction cost in kg gain	0.00	20.38	19.73	21.52	21.41	16.98

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تأثير مستويات مختلفة من البروبايوتك على أداء الأسماك والحيوية وكفاءة الاستفادة من الغذاء لأسماك البورى المغذاة علي علائق نباتية.

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أجريت هذه التجربة بمعمل إنتاج الأسماك بكلية الزراعة (سابا باشا) جامعة الإسكندرية بهدف دراسة تأثير مستويات مختلفة من البروبايوتك (*Lactobacillus* sp.,) كأضافة غذائية على نمو الأسماك وحيويتها وكفاءة الاستفادة من الغذاء وتركيب الجسم في أسماك البورى ذات وزن ابتدائى (3.75) جم والمغذاة علي علائق ذات مصادر بروتين نباتية . تم إعداد ستة علائق متساوية في الطاقة 232 كيلو كالورى طاقة ميتابوليزمية لكل 100جم غذاء ونسبة البروتين 25 % .تم التغذية علي كل عليقة في مكررتين حتى الاشباع لمدة 12 أسبوع. و كانت المعاملات كالأتى: المعاملة الاولي كنترول تحتوي علي مصادر بروتين حيوانى و نباتي وبدون اي اضافات، المعاملة الثانية تحتوي على مصادر بروتين نباتى فقط وبدون اي أضافات، المعاملات من الثالثة وحتى السادسة تحتوي على مصادربروتين نباتى فقط ومضاف اليها نسب البروبايوتك 0.5 ، 1.0 ، 1.5 ،2.0 % علي التوالى. أوضحت النتائج أن النمو وكفاءة الاستفادة من الغذاء للأسماك التي تغذت على علائق مضاف اليها البروبايوتك كان أفضل معنويا من الأسماك التى تغذت على العليقة الكنترول أو العليقة التى تحتوي على مصادر بروتين نباتى فقط ، كما لوحظ أن الأسماك التى تغذت على علائق تحتوي نسبة 1 الى 1.5% بروبايوتك كانت أفضل معنويا في معدل تحويل الغذاء ومعدل النمو النوعى ونسبة الزيادة في وزن الجسم عن باقى المعاملات. اما بالنسة لمحتوى جسم الأسماك من الرطوبة في نهاية التجربة فلم تكن هناك أى فروق معنوية بين المعاملات بينما أظهرت التحاليل المعملية ان محتوي جسم الأسماك من الدهون اختلف معنويا بين المعاملات، حيث ارتفعت نسبة الدهن معنويا في جسم الأسماك مع زيادة مستوي البروبايوتك في الغذاء حتى مستوي 1.5% . وبالمثل زاد محتوى بروتين جسم الأسماك تدريجيا مع زيادة مستوي البروبايوتك في الغذاء حيث سجلت أعلى نسبة لمحتوي البروتين في جسم الأسماك التى تغذت على العليقة التي تحتوي على 1.5%. مما سبق وتحت ظروف التجربة فيمكن التوصية بأن أفضل مستوى من البروبايوتك يمكن اضافته الي علائق الاسماك التى تحتوي على مصادربروتين نباتى فقط هو مستوي 1 % وذلك لتحسين النمو وأداء الأسماك و كفاءة الإستفادة من الغذاء لأسماك البوري بالإضافة إلى الكفاءة الأقتصادية وانخفاض تكلفة العلائق النباتية للأسماك مقارنة بالعلائق التى تحتوي علي مصادر بروتين حيوانى.